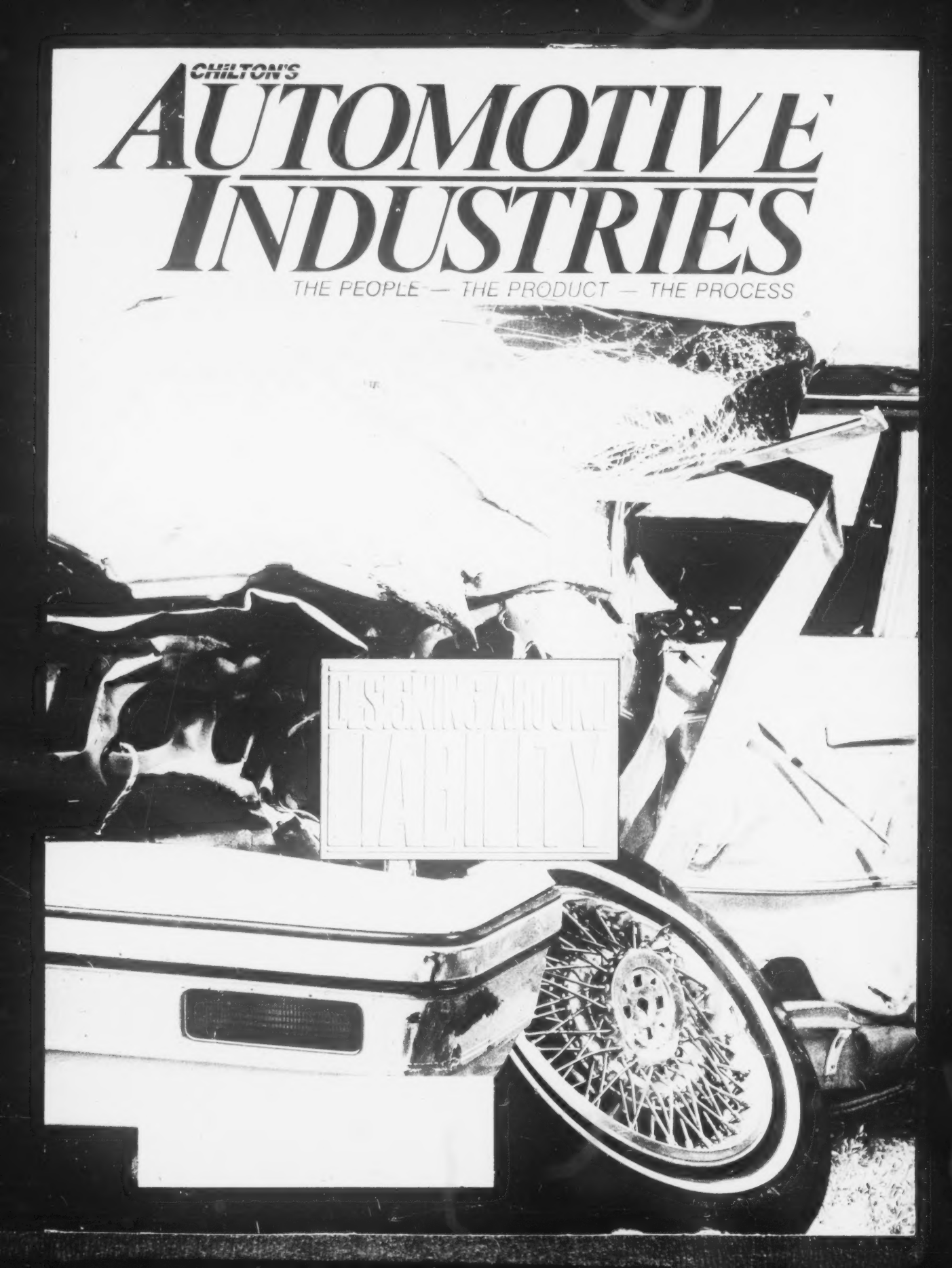
CHILTON'S

AUTOMOTIVE INDUSTRIES

THE PEOPLE — THE PRODUCT — THE PROCESS



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Unfortunately, the design engineer has become a pivotal figure in the storm of product liability claims hitting this industry. On page 32, we offer tips on how to design around potential lawsuits. Cover photo by Jay Asquini.

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Japan

Newcomer to the electronics field masters steep learning curve.

Nissan on-board navigation system on ARC-X concept car

Japanese companies have been making car electronics for just 25 years, and already they rank among the world's premiere products.

The industry, led by Nippondenso Co., Hitachi Ltd. and Mitsubishi Electric Corp., combined for sales last year in excess of 212.5 billion yen ($1.6 billion at the year average exchange rate). Including the total value of components sold, that number approached 3.838 trillion yen ($29.9 billion).

Driven by strong demand for sensors and electronic devices, GIS KK, a Tokyo-based industrial research organization, predicts that the market will reach 269.1 billion yen in 1990, nearly double 1985 levels. Industry analysts expect more than 10% yearly growth through the mid 1990s.

"The potential is unlimited," a senior Toyota Motor Corp. official declares. "And as the price of electronics continues to come down, we expect even greater usage."

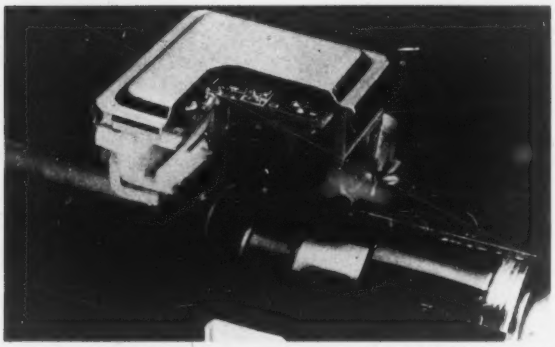
That potential, even today, includes such advanced features as head-up displays, traction control sytems, on-board navigation and car facsimilies. The near future will see the introduction of laser-warning devices, voice-activated controls and total vehicle control systems.

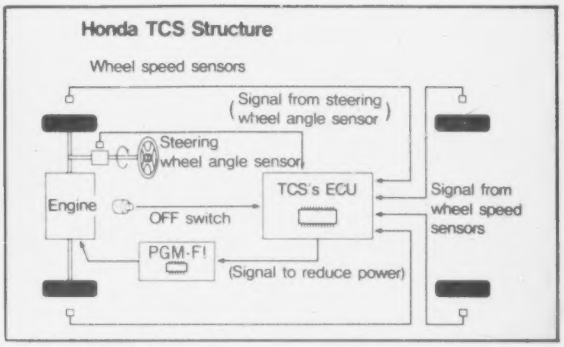
Nippondenso Co. president Taro Tanaka explains that unlike past years, when engine controls were the focal point of much of the industry's research activity, the future will see a greater emphasis placed on chassis development. All automakers, he says currently are striving for improvement in suspension, brakes and steering, and wherever possible, they would like to integrate these into a single centrally controlled system.

One example of this trend is the introduction of a continuously variable transmission by Fuji Heavy Industries two years ago. The CVT, introduced on 1.0 L Subaru Justy model, is coupled with a computer controlled electromagnetic clutch, enabling the vehicle to adjust automatically both to changing road conditions and individual driving styles. Fuji, maker of Subaru cars, claims the system can achieve as much as 20% fuel savings.

Honda's recently introduced TCS (traction control system) is the world's first production system for front drive cars. It features wheel speed sensors and a steering angle sensor; its ECU incorporates road surface algorithms and calculates yaw rates.

This past May, Nissan Motor Co. may have taken this technology one step further with its announcement of the development of a new electronically-controlled four-wheel-drive system that incorporates a lateral acceleration sensor. The new system, five





Honda traction control schematic and TCS sensor.

years in development, helps improve cornering performance by controlling the torque split to the front axle according to the vehicle's operating conditions and road surface. Nissan will soon introduce the system into production.

While all Japanese automakers have relations with particular suppliers, none is closer than Toyota's with Nippondenso. During the 1980s, the two companies have collaborated in the development of electronic engine control, back sonar and optical fiber signal control, electronic suspension four-wheel anti-skid control and electronically controlled air suspension.

In 1987, Toyota introduced, with Nippondenso the industry's first car navigation system utilizing a CD-ROM disc. More recently, this past February, it began marketing a pair of car facsimilie machines for use in Japan. The units, including one model that can be strapped over the seat, are designed to handle A4-size transmissions. Developed jointly by Toyota, Nippondenso and Aisin Seiki Co., the facsimilies were built mainly for Toyota's top-line models such as the Crown, a car that utilizes 33 microcomputers. Toyota purchased 80 million semiconductors last year.

Needless to say, Toyota is not alone in making advances into the electronics field. Nissan, Mazda Motor Corp., Mitsubishi Motors Corp. and their suppliers all are investing heavily in research and product development.

Says Stephen Usher, and industry analyst for Kleinworth, Benson Internationl: "There's considerable pressure to bring products out that work. Car electronics is one of the areas that will determine the success or failure of new products—and companies."

To illustrate, in 1983 Nissan successfully commercialized the industry's first head-up display, featured on the 240SX. The system was developed jointly with an affiliate, Kanto Seiki Co.

Four-wheel-steering is another example. Again with Nissan leading the way, introducing the first electronically controlled 4WS in 1985, two other Japanese automakers since have followed with more elaborate systems.—Mazda and Mitsubishi Motors; Toyota is expected to follow suit later this year. And Nissan, responding to the competition, has just begun marketing a more advanced 4WS.

In the car navigation field, although Toyota is the only company to have marketed a CD-ROM system to date, other manufacturers, including Nissan, Mazda and Mitsubishi Motors, all have developed prototypes.

The Toyota system, featured on its 3.0 L Crown luxury sedan, is loaded with enough maps on its 540 megabit disc to cover all of Japan—more than 1460 in all, the smallest having been sealed at 1:75,000.

In the hardware area, one theme that holds considerable interest—and potential—is local area networking. To this end, Mazda this past March announced the development of a LAN protocol for automotive electrical systems. Based around hybrid IC and custom LSI, the Hiroshima-based automaker said it plans to incorporte the new system in its cars by the end of next year.

The protocol, which was developed jointly with Furukawa Electric Co., allows for multiplexing of wires and thus offers the potential to reduce space requirements for electrical equipment in cars in addition to weight. According to Mazda, just two wires can replace as many as 6000 that fit in conventional wire harnesses, in the process reducing the net diameter of the harness by an estimated 60%; weight reduction is expected to be 11 lb. (5 kg).

Mazda's however, is not the first practical multiplex wire system to be introduced by a Japanese automaker. That distinction belongs to Nissan, which two years ago commercialized a system utilizing a custom LSI. The Nissan LAN, currently is finding use for power windows, seats and door locks, has been installed in more than 300,000 cars since making its June 1987 debut on the Cedric Gloria.

The system, developed at Nissan's electronic research laboratory, is based on a customized LSI that features an advanced noise elimination circuit. Although developed inhouse, it is being manufactured by Hitachi Ltd., Nissan's major supplier of car electronics.

The complete system, including door locks, power windows and seats, is being assembled by Nissan affiliates Niles Parts and Kanto Seiki. Monthly production currently stands at about 30,000 units, incorporating roughly 120,000 LSIs.

To date, the most significant application has been for door lock and power window controls (particularly for switches mounted on the center pad of the steering wheel such as radio, air conditioning and auto speed controls) and for a compact on-board TV.

So big are the stakes in this emerging market that companies have

started to set up special groups internally or to form joint ventures focusing solely on the car electronics field. Toshiba, is an example, last April established an automotive electronics systems office. Staffed by 20 engineers, the main function of the group is to coordinate automotive-related research activities within the organization and, where possible, to custom-design and manufacture components.

Toshiba, with long ties to Toyota and Nippondenso, already is the leading supplier of semiconductors to the Japanese auto industry. It now will seek to develop systems.

Research official Satoshi Negishi says one of the main target areas is the communications field including such areas as navigation, voice and data transmission and voice recognition. Japanese leader in both the development and production of telephone systems and equipment, Toshiba began R&D in voice recognition 16 years ago.

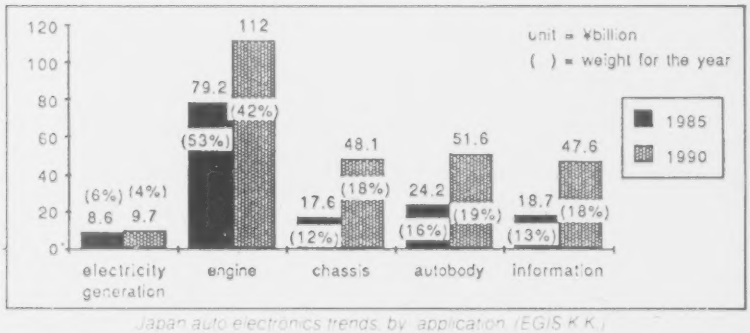
Using that as a base, it initially plans to turn its attention to auxiliary functions such as radio or stereo tuning, air-conditioning and temperature control and automatic window control. Longer term, it hopes to broaden these applications to include the basic operation of the car—driving, steering, and stopping and starting.

Likewise, Mazda and NEC have formed a joint venture, NALDEC Corp., to develop and manufacture advanced electronic components for automobiles. Production is scheduled to get under way this fall at a new 14.5 billion yen facility in the city of East Hiroshima. Mazda have indicated that the main focus of the operation, at least at the outset, will be on automotive control systems, including electronic control units for chassis and engines. All of the output is planned for use by the Mazda group.

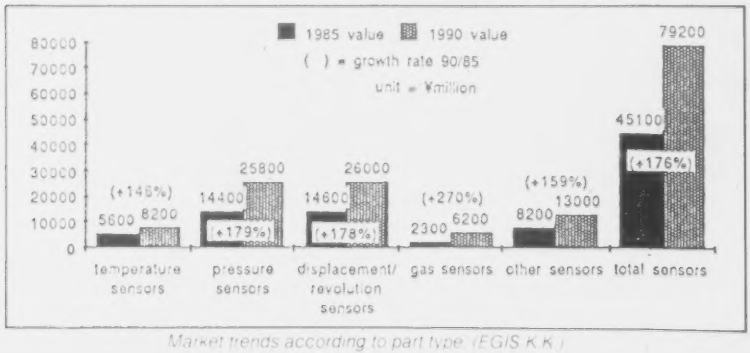
Mazda also has teamed up with Matsushita Electric Industrial Co., Japan's largest maker of consumer electronics, and Ford Motor Co. to produce car air conditioners. Japan Climate Systems Inc., a joint venture based in Hiroshima, currently is producing an estimated 100,000 car air-conditioners a year.

	1985	1990	growth 90/85
Electronic devices	61850	111830	181%
microcomputers	9670	20930	215%
ICs	4540	8100	178%
discrete semiconductors	15700	24800	158%
hybrid ICs	25600	42900	168%
displays	6340	15100	238%
Sensors	45100	79200	176%
temperature sensors	5600	8200	146%
pressure sensors	14400	25800	179%
displacement/revolution sensors	14600	26000	178%
gas sensors	2300	6200	270%
other sensors	8200	13000	159%
Passive parts	10860	19880	183%
coils and transformers	1200	2400	200%
capacitors	4840	8900	184%
resistors	2920	5080	174%
LCR compound parts	1900	3500	184%
Mechanical parts	20200	38600	191%
switches	13000	26400	203%
connectors	7200	12200	169%
Functional parts	10500	19600	187%
motors	9500	17400	183%
speakers and buzzers	300	800	267%
oscillators	700	1400	200%
GRAND TOTAL	148510	269110	181%

Analysis of Japan's automotive electronics market by devices and parts. (EGIS K.K.)



Japan auto electronics trends, by application. (EGIS K.K.)



Market trends according to part type. (EGIS K.K.)